

HERPETOFAUNAL SURVEY OF THE PINE HILLS AREA OF SOUTHERN ILLINOIS

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The Pine Hills area of southern Illinois has long been of interest to biologists because of the mixture of northern and southern flora and fauna occurring there. An examination of the relationships and ecology of this flora and fauna may provide a key to an understanding of the flora and fauna of the entire middle Mississippi Valley. Gunning and Lewis (1955) have reported on the fish, Layne (1958) on the mammals, and Mohlenbrock (1959) on the vegetation. The present paper summarizes our knowledge of the Pine Hills herpetofauna.

There are a number of references to the amphibians and reptiles of Pine Hills, but, with the exception of Smith (in press), none presents a complete list of the forms which are present. These other references include Garman (1892), Blanchard (1942), Minton and Minton (1948), Smith (1948, 1950), Stein (1954, 1955), Gunning and Lewis (1955), Layne (1957), Smith and Minton (1957), Thurow (1957), and Keiser (1958).

The Pine Hills area (referred to in this paper simply as Pine Hills) is located approximately two miles east of Aldridge in northwestern Union County, Illinois. It includes the three miles of north-south oriented bluffs called the Pine Hills, as well as the large swamp which lies at the foot of the bluffs in the Mississippi River floodplain (the swamp has been known both as La Rue Swamp and, more frequently, Pine Hills Swamp). The Big Muddy River is immediately to the north of Pine Hills; Wolf Lake Swamp is to the south. The area lies within the Alto Pass Quadrangle (U. S. Geological Survey topographic map, 15 minutes series) and forms a portion of the Salem Plateau Section of the Ozark Plateaus physiographic province.

Data on air temperature, precipitation, and other climatic features of Union County are summarized by Cagle (1942).

The eastern part of the area is characterized by dry limestone bluffs which rise 150 to 350 feet above the floodplain. These bluffs often have exposed vertical faces with talus slopes at their base. Oak-hickory forest covers the midslope and an oak forest the upland

(Rensing, MS). Small hill prairies are scattered along the western edge of the blufftops. Below and to the west of the bluffs lies a lowland red maple—honey locust—swamp cottonwood forest (Mohlenbrock, 1959). A swamp, fed by springs in the bluffs, occupies a large area west of this forest, and in places fingers of the swamp reach as far east as the gravel road which runs the length of the bluffs. The largest of the springs emerges from the base of a sheer cliff and its water flows immediately into the swamp; there is no clearly defined spring run. Each of the other springs is rather small, rises at the foot of a talus slope, and has a rocky run over which the water flows before reaching the swamp. Water temperature of the springs varies but little during the year from an average annual temperature of 13.3° C. Pumpkin ash, buttonbush, and water willow are the most abundant woody plants of the swamp. Duckweed and green algae cover the surface of the water in many places, and various grasses line the swamp margin. The swamp contains countless stumps and fallen trees. The area also contains three borrow pits which have a greater depth of water than the swamp but less aquatic vegetation.

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Unless otherwise noted, all the species listed are represented by preserved specimens in the collections of the Illinois Natural History Survey and the University of Illinois Museum of Natural History in Urbana, or in the personal collection of the author. Taxonomic discussions are based almost entirely on material in the latter collection.

AMPHIBIANS

Siren intermedia nettingi Goin. Gunning and Lewis (1955) have reported the Western Lesser Siren to be among the most abundant of the amphibians in the swamp, but it is rarely obtained by most collectors. Their use of an electrical shocker to stun aquatic forms ordinarily obtainable only by seining (Gunning and Lewis, 1957) may well account for their success. Lesser sirens ordinarily are collected in the vicinity of culverts in the early evening. They are active throughout the year.

Ambystoma maculatum Shaw. The Spotted Salamander occurs in two distinct microhabitats in Pine Hills—lowland woods and dry talus slopes, the latter a rather unusual habitat. Individuals probably wander up the dry face of the slopes in rainy weather or on cool evenings when they can avoid desiccation, but the reason for their seeking higher levels is not apparent. Salamanders taken from talus slopes have been either in or under rotten logs, but one specimen was collected in association with a ringneck snake under a flat stone at the base of the bluff. *A. maculatum* has been collected in February, March, April, August, September, and October.

Ambystoma opacum Gravenhorst. The Marbled Salamander is usually found beneath rotten logs and old boards in moist lowland woods. Minton and Minton (1948) collected one in loose soil beneath a large rock at the base of a cliff. None have been collected on the talus slopes. Individuals have been observed in April, May, August, September, October, and December.

Ambystoma talpoideum Holbrook. The Mole Salamander has been taken only once, in mid-October, in moist humus beneath a rock high on a dry talus slope. Apparently it shares the tolerance of *A. maculatum* for relatively dry habitats. The specimen, an adult male, is 20 mm. longer than any previously recorded example (117 mm. to the previous 97 mm.).

Ambystoma texanum Matthes. Adults of the Small-Mouthed Salamander are most easily collected during spring when they enter ponds for breeding. By the latter half of May the large-headed, darkly pigmented larvae have reached a total length of about 56 mm. At this time the upper gill ramus extends posteriorly to the sixth costal groove. By the second week in June a number of individuals have transformed. They have reached a total length of about 61 mm., the increase being almost entirely in tail length. The old larvae are noticeably lighter in color than the young larvae. The head has assumed the shape typical of adult *A. texanum*, and the upper gill ramus does not extend as far posteriorly as the foreleg. Most of the transformed specimens were collected under old boards near a pond. A number were found in association with *Plethodon g. glutinosus*. Small-mouthed salamanders have been observed in April, May, June, October, and December.

Ambystoma tigrinum tigrinum Green. Dr. Philip Smith informs me that there was an Eastern Tiger Salamander from Pine Hills in

the Southern Illinois University Museum collection several years ago. An inquiry in April 1958 revealed no record of this specimen in the Museum card file; it may be that the specimen is lost. This salamander is frequently encountered in the hill country to the east and may be expected to occur in Pine Hills.

Diemictylus viridescens louisianensis Wolterstorff. The newts of Pine Hills are identifiable as *D. v. louisianensis* in spite of the fact that they attain a much greater length than is recorded for the race (122 mm. compared to 89 mm.). Despite the similarity in size to *D. v. viridescens*, adults lack any trace of red dorsolateral spots and have heavily black-spotted dorsa. The eft stage is not coral red but has a rusty brown dorsum which contrasts with the orange venter. The dorsum is spotted with black and the red spots in the dorsolateral row, when present, are less than half the size of those on typical *D. v. viridescens* efts of comparable length.

The aquatic stage is usually found only in the spring of the year and has been found in numbers both in wooded lowland pools and in the swamp. The eft stage is found most frequently in late summer and fall (one was taken in late April), and are usually discovered under rocks and logs, often a great distance from water. One eft was collected under a log on a high, dry talus slope in association with an adult *Rana pipiens*.

Desmognathus fuscus subspecies. Smith (1948) has reported *D. f. fuscus* from Pine Hills, but in a later work (in press) discounts the earlier record because no further specimens have been taken since that date. If this salamander is present, it undoubtedly represents a peripheral colony of the spotted dusky salamander, *D. f. conanti*, rather than *D. f. fuscus*. The only known Illinois population of *conanti* is in Pulaski County.

Plethodon dorsalis angusticlavius Grobman. The Red-Backed Salamanders of Pine Hills have been a source of taxonomic controversy in recent years. Thurow (1957) believes them to be *P. d. angusticlavius*, whereas Smith and Minton (1957) state that there is an isolated colony of *P. cinereus* (presumably the subspecies *cinereus*) in Pine Hills. Dr. Richard Highton examined a series of live specimens from the area and identified them as *P. dorsalis* (no subspecific identification was given). This series included the most *cinereus*-like individuals I could find. Grobman (1944) has stated that the ratio of stripe width to body width (expressed as a

per cent) for *angusticlavius* is 28, for *P. c. cinereus* 45. The ratio for a series of 14 Pine Hills red-backs is 28.8 (24.5-32.3). The margins of the dorsal stripe are not sharply defined, but no zigzag pattern is evident on any specimen examined. Occasional specimens have a yellow, rather than red, dorsal stripe. There is little reason to doubt that the Pine Hills population belongs to the subspecies *angusticlavius*, regardless of the species designation.

During the warmer months the Red-Backed Salamander is found beneath rocks and logs on the sides of the bluff. During the colder months many become inactive, usually coiling tightly upon themselves like watch springs. However, near one of the small springs, they remain active, most specimens occurring in rock rubble and leaf debris along the spring run. Occasionally individuals are found completely submerged in the cold water. Winter submergence has been recorded for *P. c. cinereus* (Cooper, 1956), but not for *angusticlavius*. At this spring, gravid females have been observed in early February.

The red-backs are found near the spring only during the colder months, at which time there are virtually no adult *Eurycea* active (occasionally a larvae is found). During the warmer months, however, both species of *Eurycea* are abundant. This seasonal succession may tend to reduce competition. *Acris gryllus*, *Rana pipiens*, and *Rana clamitans* are frequently associated with the red-backs in and along the spring run.

Plethodon glutinosus glutinosus Green. The Slimy Salamander is infrequently encountered; my only records are for April, May, and September. Specimens are usually collected in moist, sheltered situations although several were observed wandering about on the forest floor on a warm, rainy evening.

Eurycea longicauda longicauda Green. Comparison of Long-Tailed Salamanders from Pine Hills with a series from northern New Jersey has revealed no significant differences. The animals are not *E. l. pernix* as indicated by Mittleman (1942), neither do they show any apparent influence from *E. l. melanopleura*. For that matter, a small series from Monroe County, Illinois, approximately 55 air miles northwest of Pine Hills, also shows no indication of *melanopleura* characters. The relationships of the two subspecies in Illinois could well afford re-examination.

Hovde (MS) demonstrates that larvae tend to exceed newly transformed individuals in size. The largest larva measured 80 mm.; the smallest transformed specimen 44 mm. Apparently the larval stage lasts at least two years, possibly longer. The presence of very tiny larvae from November through March indicates an extended breeding season of at least five months. Larvae are active in the springs and spring runs throughout the year, feeding chiefly on amphipods. Small larvae are virtually black while the large larvae are rather nondescript in appearance with an olivaceous dorsum mottled with dark pigment. The newly transformed salamander, with its black sides, dark chin, dorsolateral row of white spots, and olive-grey dorsum, looks nothing at all like an adult *E. longicauda*.

Adults are most frequently taken under rocks, rotten logs, or leaf debris along the spring runs. On warm evenings during or after a rain, *E. longicauda* has been found in association with *E. lucifuga* on the walls and in crevices in a twilight cave, on the bluff face adjacent to the cave (apparently restricted to moss-bearing rocks), and wandering about on the ground. Adults are active throughout the year.

Eurycea lucifuga Rafinesque. The Cave Salamander appears to be less abundant than *E. longicauda* along the spring runs, but it is the more abundant of the two species in the cave, especially at night. Like the Long-Tailed Salamander, *E. lucifuga* is active throughout the year.

The larvae of *E. lucifuga* have not been found in Pine Hills. Since the larvae of the two species of *Eurycea* are very similar, one might suspect some of Hovde's specimens were misidentified. However, of 27 larvae which he chemically induced to transform, all proved to be *E. longicauda*.

Bufo americanus subspecies. Conant (1958) has indicated that the American Toads of southern Illinois belong to the subspecies *charlesmithi*. This is not an entirely satisfactory arrangement because many southwestern Illinois specimens do not agree well with published descriptions of the Dwarf American Toad, but appear to be similar to *B. a. americanus*. Clarification of the status of the American Toads of this area is perhaps the most pressing taxonomic problem affecting Pine Hills herpetology.

Specimens have been collected only in April and October.

Bufo woodhousei fowleri Hinckley. Fowler's Toad is more abundant than *Bufo americanus*. The two species may possibly hybridize. Specimens have been encountered in the lowland woods and occasionally on the road in April, May, June, and July.

Acris gryllus blanchardi Harper. Cricket Frog choruses have been heard and newly transformed individuals observed in mid-July. *Acris* is probably the hardiest frog in Pine Hills, remaining active about the springs in midwinter when all areas of still water are frozen solid.

Hyla avivoca avivoca Viosca. Specimens of the Western Bird-Voiced Treefrog from Pine Hills are distinguishable from small *Hyla versicolor* only in having a pale green rather than yellowish-orange groin and a brown rather than grey dorsum. Individuals found during summer were calling from trees or bushes in the swamp. Fall-collected frogs are invariably found in lowland woods and exhibit terrestrial tendencies. This is apparently characteristic of all the *Hyla* of the area. *H. avivoca* has been observed from April through October.

Hyla cinerea Schneider. The Green Treefrog is the most frequently encountered *Hyla* in Pine Hills. Both amplexing adults and newly transformed individuals have been seen in mid-July. These treefrogs have been collected from April through October.

Hyla crucifer crucifer Wied. Choruses of Northern Spring Peepers have been heard when the air temperature was only 1.1° C. and ice was forming on the shallow roadside ditches. Spring peepers are much less abundant in the fall than the other hylids and have been observed only in March, April, and October.

Hyla versicolor versicolor Le Conte. In late spring Eastern Grey Treefrogs may be heard calling during the day from the tops of tall trees at the margin of the swamp; they do not descend until after dark. *Hyla versicolor* seems to prefer drier situations than does *H. cinerea*. The possibility of an ecological separation between *H. versicolor* and *H. avivoca* should be investigated. The Grey Treefrog shares the activity pattern of most of the other summer-breeding hylids in being active from April through October.

Pseudacris nigrita triseriata Wied. The Chorus Frogs of Pine Hills apparently represent a population of "pure" *triseriata* situated well within the zone of intergradation between that race and the southern subspecies *feriarum*. Tibia/body ratio (expressed as a per

cent) for a small series of males from Pine Hills is 40.8 (39.7-41.6). This is in marked contrast to the 46.2 (41.2-52.6) value for 10 populations from the zone of intergradation immediately to the north-east, and agrees closely with the 41.1 (37.6-46.5) mean for two *triseriata* populations from northern Illinois (Rossman, 1959). It appears that *triseriata* has been able to invade southwestern Illinois from the north by way of the Mississippi River floodplain and has withstood the influence of *feriarum*-like frogs from the hill country to the east. This is all the more remarkable in that Smith and Smith (1952) have shown *P. n. feriarum* to be the bottomland form in the Ohio River Valley.

Chorus Frogs have a very limited distribution in Pine Hills having been collected in only one pond. *Pseudacris* has been observed only in March and April.

Rana catesbeiana Shaw. Young Bullfrogs are active most of the year in the vicinity of the springs but do not appear to be as hardy as *Acris* and the other two species of *Rana*.

Rana clamitans. The Green Frogs at Pine Hills appear to be intergrades between *R. c. clamitans* Latreille and *R. c. melanota* Rafinesque. Meham (1954) states that individuals from Alexander County, Illinois, are unusual in having dusky to black mottling or vermiculations on the belly, pectoral region, and throat. He says also that specimens from the adjacent counties have unmarked bellies. The majority of Pine Hills specimens (especially juveniles and subadults) have a heavily pigmented belly, the markings in some cases forming a reticulum. Meham also mentions that males with green jaws and yellow throats are absent from the Mississippi floodplain of Union County. Although infrequent, such specimens do occur in Pine Hills.

Green Frogs are abundant throughout the year in and adjacent to the springs. Young frogs and subadults usually take shelter beneath rocks and logs along the spring runs during the cold months of the year.

Rana pipiens sphenoccephala Cope. The Southern Leopard Frog is one of the three anuran species which is active throughout the year. All age groups reach their greatest abundance in and around the springs. One adult was collected in association with a *Diemictylus* eft beneath a log on a dry talus slope.

REPTILES

Chelydra serpentina Linnaeus. The Common Snapping Turtle is rarely seen except on the road or in the lowland woods when the female comes on land to lay her eggs. I have seen snappers in April and May.

Sternotherus odoratus Latreille. The Stinkpot is the most frequently encountered turtle of the area. It has been observed in January, March, May, June, July, and August.

Terrapene carolina carolina Linnaeus. The Eastern Box Turtle is far less abundant in Pine Hills than it is in the hill country to the east. Specimens have been found on the road and in lowland woods in May and June. No influence from *T. c. triunguis*, which is common on the Missouri side of the river, has been noted.

Chrysemys picta. The few specimens collected appear to be intergrades between the western (*C. p. belli* Gray) and midland (*C. p. marginata* Agassiz) painted turtles and show no influence from the southern subspecies *C. p. dorsalis*. Several specimens have been taken on the road, and on June 12, 1955, a large female (carapace length approximately 160 mm.) was discovered laying eggs in a weedy field about 30 yards from the nearest water. Specimens have also been collected in April and May.

Pseudemys scripta elegans Wied. The Red-Eared Turtle is most frequently seen on the road when females emerge from the swamp to lay eggs. R. Earl Olson observed several females laying eggs on June 6, 1953. I have also seen this species in May.

Trionyx spinifer subspecies. On June 13, 1956, Ed Keiser collected the first specimen of the Spiny Softshell known from Pine Hills. I have not examined it and cannot say with certainty if the animal is a typical *T. s. hartwegi* or a *hartwegi* X *spinifer* intergrade.

Sceloporus undulatus hyacinthinus Green. The Northern Fence Lizard is the most abundant lizard and is most frequently found on or near the bluff. Fence lizards have been found from February through October.

Lygosoma laterale Say. The Ground Skink has been found in May and June in lowland woods, along the base of the talus slopes, and on top of the bluff. Foraging specimens are usually detected by the rustling noise that marks their passage through dead leaves and grass.

Eumeces fasciatus Linnaeus. Most specimens observed were on rocks or trees in the immediate vicinity of the bluff. Non-bluff-dwelling *Eumeces* were usually found around old abandoned wooden buildings. Specimens have been collected from April through October.

Eumeces laticeps Schneider. Stein (1954) reports the Broad-Headed Skink from Pine Hills. I have seen no specimens.

Natrix cyclopion cyclopion Duméril, Bibron, and Duméril. Keiser (1958) reports the rediscovery of this species in Illinois after an apparent absence of 50 years, and records its presence in Pine Hills for the first time. Specimens have been found on the road and in open and sheltered situations on the margin of the swamp. Four specimens measure from 358 to 991 mm. in length. Individuals have been collected in March, September, and October.

Natrix erythrogaster. The Plain-Bellied Water Snakes of this area appear to be intergrades between *N. e. flavigaster* Conant and *N. e. neglecta* Conant, and are the most abundant of the four species of *Natrix*. *N. erythrogaster* is both diurnal and nocturnal and during the day may wander some distance from water. Most individuals, however, are found near the swamp. Two specimens have been taken from the previously mentioned twilight cave, which may serve as a denning site for this species. On several occasions the snake guinea worm *Dracunculus ophidensis* has been observed to emerge from open sores on the backs of yellow-bellies.

The local *erythrogaster* exhibit a wide range of variation in coloration ranging from grey to dark brown dorsa, and pale orange-yellow to red venters. I have collected yellow-bellies ranging from 300 to 1095 mm. in length. These snakes are active from February through October.

Natrix rhombifera rhombifera Hallowell. The Diamond-Backed Water Snake is the largest *Natrix* in Pine Hills, attaining a length of 1295 mm. It has been collected from February through September both at night and during the day, but always in the immediate vicinity of water.

Natrix sipedon pleuralis Cope. Despite the abundance of this species elsewhere in southern Illinois, the Midland Water Snake is the least abundant *Natrix* in Pine Hills. It has been observed only in April and May, and is both diurnal and nocturnal.

Storeria dekayi wrightorum Trapido. The Midland Brown Snake has been taken both in open and sheltered situations during the months of April, May, July, and October, frequently near water.

Storeria occipitomaculata occipitomaculata Storer. The Northern Red-Bellied Snake is rare in Pine Hills; it has been collected only in March and April. C. Robert Shoop reports that an erythristic phase appears in Pine Hills in addition to the normally pigmented one.

Thamnophis sauritus proximus Say. The Western Ribbon Snake is infrequently seen in Pine Hills; my only records are for March, April, and October. All specimens have been collected in open situations near the base of the bluffs. The ribbon snake in this area is brightly marked with an orange dorsal stripe and greenish-white lateral stripes contrasting with a black dorsum.

Thamnophis sirtalis sirtalis Linnaeus. Eastern Garter Snakes have been collected during May, June, August, and October. All the individuals were juveniles or subadults. One specimen was found beneath a log in wetwoods; other individuals have been in open situations.

Virginia valeriae elegans Kennicott. The Western Earth Snake is relatively abundant in Pine Hills; specimens usually are found under rocks or debris. Occasional nocturnal activity has been observed in this species. Earth snakes have been collected every month of the year except February, March, July, and November.

Heterodon platyrhinus Latreille. The Eastern Hognose Snake is rare in Pine Hills. An erythristic adult collected in September beneath a log in lowland woods is the only specimen I have seen.

Diadophis punctatus. Gloyd, in Blanchard (1942), examined three Ringneck Snakes from Pine Hills and concluded that they were "fairly typical of *arnyi* in structural characteristics but in the spotting of the belly show tendencies toward *stictogenys*." Critical examination of 12 recently collected ringnecks (7 males and 5 females) reveals that the Pine Hills population consists of intergrades between *D. p. edwardsi* Merrem and *D. p. stictogenys* Cope. No individual is similar to *D. p. arnyi* in scutellation or belly pattern; none has red caudals or the accompanying caudal display behavior characteristic of *arnyi*. All have 15 dorsal scale rows, a trait shared by *D. p. edwardsi* and *D. p. stictogenys*. Eight of the snakes have

seven supralabials, three have eight, and one has eight on the left side and seven on the right. In this character they are closer to the subspecies *stictogenys* which usually has seven supralabials. In regard to width of the light neck band, half the bands fall within the shared range of variation for both subspecies, two neck bands are too narrow for *D. p. edwardsi*, and four are too broad for *D. p. stictogenys*.

Table I compares ventral and caudal counts of Pine Hills ring-necks with data presented by Blanchard (1942).

TABLE 1
COMPARISON OF VENTRAL SCUTELLATION OF PINE HILLS
DIADOPHIS WITH THE SUBSPECIES *EDWARDSI*
AND *STICTOGENYS*

Sex		<i>edwardsi</i> ¹		Pine Hills		<i>stictogenys</i> ¹	
		M	F	M	F	M	F
Ventrals	Mean	151	160	149	160	133	142
	Range	(139-162)	(146-176)	(145-153)	(157-164)	(126-143)	(137-150)
Caudals	Mean	57	51	49	43	46	39
	Range	(48-65)	(41-61)	(46-54)	(41-46)	(38-51)	(33-43)

¹ From Blanchard (1942).

On the basis of ventrals alone, the Pine Hills snakes would be assigned to *edwardsi*. In caudal count, however, they are clearly intermediate, although somewhat closer to *stictogenys*. The ventral pattern shows a strong affinity to *stictogenys*: five individuals have ventral spots clustered near the midline and frequently fusing to form a transverse bar, three have a similar arrangement but lack bars, two have essentially a single median row of fairly large spots, at least anteriorly, and one has a virtually unspotted venter. Spotting of the infralabials and chin shields varies similarly.

From the descriptions Blanchard gives of two specimens from Alto Pass in Union County (one he called an *edwardsi*, the other an aberrant *arnyi*), it would seem reasonable to consider them *D. p. edwardsi* X *stictogenys* intergrades also. I doubt that any *arnyi* influence is expressed as far south in Illinois as Union County.

The ringneck snake is the most abundant of the small secretive snakes. Although this species is active from March through October, ringnecks are most numerous in the fall; the majority of fall-

collected snakes are small and presumably young of the year. A ringneck taken in March was found with an *Ambystoma maculatum*.

Carphophis amoenus helenae Kennicott. Stein (1954) has reported *C. a. amoenus* from Pine Hills, but this record is probably in error since the nominate subspecies has not been recorded nearer than eastern Tennessee by other authors. The Midwest Worm Snake is less abundant than *Diadophis* and *Virginia*, but has been collected much more frequently than the Red-Bellied snake. Specimens have been taken near the bluff under rocks and beneath tar paper from April through September.

Farancia abacura reinwardti Schlegel. The Western Mud Snake has been collected from March through October, but its relative abundance is difficult to assess because of its aquatic habits. Two of eight specimens were collected at night. A 940 mm. mud snake was regurgitated by a 1067 mm. cottonmouth.

Coluber constrictor. Superficial examination seems to indicate that Pine Hills racers are intergrades between the Blue (*C. c. foxi* Baird and Girard) and Southern Black (*C. c. priapus* Dunn and Wood) Racers. The snakes are black dorsally but have a distinct bluish cast to the venter. My largest specimen measures 1397 mm.

The racer is an extremely active snake from March through October and has been taken throughout the area in practically every habitat except the swamp proper. It is found rather frequently on talus slopes. Pursued specimens often climb into bushes and shrubs. A large female, collected May 5, 1957, deposited a clutch of 19 nonadherent, granular-surfaced eggs on June 7. These averaged 32.4 mm. (30.1-36.5) in length and 19.5 mm. (18.4-20.2) in width.

Opheodrys aestivus aestivus Linnaeus. The Eastern Rough Green Snake is not abundant in Pine Hills. Several specimens have been found in the swamp on lotus leaves or in clumps of marsh grass. It has been observed from May through October.

Elaphe obsoleta obsoleta Say. The Black Rat Snake in Pine Hills does not show an approach to the southern subspecies *spiloides* as do many specimens from adjacent parts of southern Illinois. Some specimens possess orange venters, a condition not previously recorded for this subspecies. It is a relatively abundant snake and is found most often on the road or near the bluffs, occasionally in trees. Layne (1957) discovered a dormant Black Rat Snake in a

crevice in a bluff in December. The longest *E. o. obsoleta* from the area measures 1930 mm. Specimens have been observed in April, June, August, September, October, and December.

Lampropeltis getulus. Smith (in press) includes Pine Hills in the zone of intergradation of the Black (*L. g. niger* Yarrow) and Speckled (*L. g. holbrooki* Stejneger) King Snakes. The small series available for my examination appears to be much closer to *L. g. niger* in pattern. The king snake is not frequently encountered, specimens having been collected in April and May in both open and sheltered situations. The largest specimen measures 1207 mm.

Lampropeltis doliata sypila Cope. The Red Milk Snake is the more abundant of the two species of *Lampropeltis* in Pine Hills, a situation which is markedly reversed in the adjacent parts of southern Illinois. Minton and Minton (1948) report finding lizard eggs in the stomachs of two Red Milk Snakes. I have found *sypila* under rocks on the talus slopes from April through July.

Cemphora coccinea Blumenbach. Bennett (1953) reports that Dr. Fred Cagle collected a Scarlet Snake in Wolf Lake Swamp in 1942. Since Wolf Lake Swamp is continuous with Pine Hills Swamp to the north, it is probable that the species also occurs in Pine Hills. No specimens have been collected since that date and the present-day occurrence of the Scarlet Snake in the area awaits substantiation.

Tantilla gracilis hallowelli Cope. The Northern Flat-Headed Snake was first reported from Pine Hills by Smith (1950). Dr. Smith advises me that most of his specimens of this secretive form were collected from the dry talus slopes along the bluffs, but some were found on the road.

Agkistrodon contortrix. Gloyd and Conant (1943) show Pine Hills lying within the zone of intergradation of the Southern (*A. c. contortrix* Linnaeus) and Northern (*A. c. mokeson* Daudin) Copperheads. Copperheads from Pine Hills appear identical to *A. c. contortrix* in color and are also closer to that race in width of dorsal band. It is the least abundant venomous snake in the area. Specimens have been collected both on the road and on the bluffs in April, May, July, September, and October.

Agkistrodon piscivorous leucostoma Troost. The Western Cottonmouth is undoubtedly the most abundant snake in Pine Hills.

A reliable observer reports seeing 50 individuals on the road in one day. In both spring and fall cottonmouths crawl across the road throughout its length as they move from talus slopes to swamp or vice versa. Dyke Howell reports finding a den of cottonmouths in a bluff crevice on March 25, 1959. The narrow crevice extended about 20 feet into the bluff and contained 15 to 20 snakes. The cottonmouth is apparently less affected by cold weather than most of the other snakes; it may be found on almost any warm day in midwinter. A freshly collected cottonmouth regurgitated an adult *Farancia*. The largest *A. p. leucostoma* measures 1194 mm. in length.

Crotalus horridus atricaudatus Latreille. Graham (1958) reports that 29 rattlesnakes from Jackson and Union Counties (including a few specimens from Pine Hills) agree with *C. h. atricaudatus* in all characters except number of dorsal scale rows. Approximately 70 per cent have 25 rows, 15 per cent 24 rows, and 15 per cent 23 rows. Graham interprets the occurrence of less than 25 rows (the usual number for *atricaudatus*) to indicate intergradation with *C. h. horridus*. In view of the agreement with *C. h. atricaudatus* in all other characters and the predominance of 25 dorsal scale rows, I consider them to be *atricaudatus*. The possible influence of *C. h. horridus* is not denied, but if it exists it is apparently of little consequence.

The Canebrake Rattlesnake is not abundant in Pine Hills and all but two specimens were collected on the road. One exception was collected in lowland woods; the other was sunning on rocks at a hibernating site on the talus slope. The rattlesnake has been observed from May through October.

DISCUSSION

A number of amphibians and reptiles not presently known to occur in Pine Hills may be collected in the future. These animals fall into three categories: forms which occur along the bluff to the north and south of Pine Hills—*Rana palustris* and *Cnemidophorus sexlineatus*; aquatic forms occurring in the Big Muddy River which could enter Pine Hills when the river is in flood stage—*Necturus m. maculosus*, *Macroclmys temmincki*, and *Graptemys pseudogeographica*; forms occurring in the hill country to the east which rarely occur in the Mississippi floodplain—*Rana sylvatica*

and *Lampropeltis c. calligaster*. An additional form, *Scaphiopus h. holbrooki*, has been recorded from two localities within a few miles of Pine Hills (one in the floodplain, the other in the hill country).

In analyzing the geographic composition of the Pine Hills herpetofauna one is impressed by the large number of forms which reach a limit of their range at or within a few miles of Pine Hills. These extraneous elements make up fully 40 per cent of the total herpetofauna, a marked contrast to the 22 per cent reported for both the fish (Gunning and Lewis, 1955) and the vegetation (Mohlenbrock, 1959).

The 31 intraneous forms (ones which do not reach a range limit near Pine Hills) include, for the most part, species and subspecies which range widely through eastern and southern United States. Almost no western elements are included. The 21 extraneous units may be placed into three categories with reasonable convenience. The southern element includes those forms which in general are found from the lower Mississippi Valley west to eastern Texas and eastward south of the Fall Line. The northern element includes amphibians and reptiles occurring east of the Great Plains and north of the Missouri River and the Fall Line. Members of the western element are generally found only west of the Mississippi River. Components of the three extraneous groups are listed below. Those intergrading forms which markedly resemble one parent stock more than the other are included and marked with an asterisk.

Southern	Northern
<i>Ambystoma talpoideum</i>	<i>Pseudacris nigrita triseriata</i>
<i>Hyla a. avivoca</i>	<i>Eurycea l. longicauda</i>
<i>Hyla cinerea</i>	<i>Terrapene c. carolina</i>
<i>Natrix c. cyclopion</i>	<i>Elaphe o. obsoleta</i>
<i>Carphophis amoenus helenae</i>	<i>Lampropeltis getulus niger*</i>
<i>Agkistrodon c. contortrix*</i>	
<i>Agkistrodon piscivorous leucostoma</i>	Western
<i>Crotalus horridus atricaudatus</i>	<i>Plethodon dorsalis angusticlavius</i>
	<i>Thamnophis sauritus proximus</i>
	<i>Tantilla gracilis hallowelli</i>

Intergrading forms which appear to be completely intermediate between parent stocks (or on which data is insufficient) belong to the following groups: *Chrysemys picta*—western and northern; *Rana clamitans*, *Natrix erythrogaster*, *Diadophis punctatus*, and *Coluber constrictor*—northern and southern. Table II summarizes the geo-

graphical affinities of the herpetofauna by order. Each of the "mixed" intergrades contributes one half unit for each parent stock area.

It is evident that snakes make up the bulk of the extraneous elements. Fifty-five per cent of the snakes are extraneous whereas no more than a third of the other orders are. Apparently the snakes have been able to utilize the available corridors (*e.g.*, the Mississippi Valley) and overcome the more formidable barriers (*e.g.*, the Mississippi River) to a greater extent than have the other reptiles and amphibians.

TABLE II

GEOGRAPHICAL AFFINITIES OF THE PINE HILLS HERPETOFAUNA

	Intraneous	Extraneous			Total
		Southern	Northern	Western	
Salamanders	7	1	1	1	10
Frogs and toads	7	2½	1½	0	11
Turtles	3	0	1½	½	5
Lizards	4	0	0	0	4
Snakes	10	6½	3½	2	22
Total	31	10	7½	3½	52

Of the extraneous elements 48 per cent are southern in origin, 36 per cent are northern, and 16 per cent are western. This contrasts rather sharply with the previously mentioned reports on the fish and vegetation in which the southern elements constitute 100 per cent and 93 per cent of the extraneous forms respectively. The southern group apparently moved northward in the Mississippi embayment where it enjoyed an essentially coastal plain flora and fauna. Although most of that group extend up the Valley to the north of Pine Hills, almost none of them has penetrated very far east of the Pine Hills. The northern elements have either utilized the Valley to come south (*Pseudacris* and *Elaphe*) or have moved in from the hill country, but have been unable to surmount the barrier presented by the Mississippi River. Few western elements have been able to cross the river, and these, like the southern forms, have not penetrated far to the east of the Valley.

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